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Production and Processing Performance of Narrow-Row Stripped Cotton in the Irrigated West

Contents

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The feasibility of a narrow-row once-over harvest system for western area cottons was evaluated. The study objectives were to determine (1) if western cottons produced in narrow rows and harvested with stripper harvesters equipped with field extractors will require more elaborate seed cotton cleaning systems in the gin and (2) if the textile mill processing and spinning performance of narrow-row stripped cotton is comparable to that of conventional-row picked cotton. Elaborate seed cotton cleaning systems removed more trash than moderate seed cotton cleaning systems, but ginned lint trash contents were not significantly different following two stages of lint cleaning. Trash content of stripped cotton was higher than that for picked cotton at all stages of processing. There were no other practical differences in fiber or yarn properties for the different harvesting and ginning treatments.

Keywords: Cotton, stripper, picker, narrow row, production, ginning, spinning.

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PRODUCTION AND PROCESSING PERFORMANCE OF NARROW-ROW STRIPPED COTTON IN THE IRRIGATED WEST

By I. W. Kirk, L. M. Carter, C. K. Bragg, R. G. Curley, and O. D. McCutcheon[1]

Introduction

Recent interest in the production of cotton in row patterns or systems narrower than the conventional 38- to 40-inch-row width has raised many questions on the feasibility of these production schemes for the high-quality cottons produced in the irrigated western areas of the United States. Considerable research effort and resources have been devoted in these areas to evaluate the feasibility of narrow-row systems in agronomic characteristics, production potential, cost reduction, and pest management (Arle *1973*, Briggs et al. *1971*, Buxton *1978*, Buxton et al. *1977*, Curley et al. *1970*, *1971-73*, George and Yeary *1977*, Johnson et al. *1974*, Payne et al. *1976*, Porteous *1977*, Walhood and Yamada *1972*[2]). As with any new system, these factors will require much attention; however, cottons grown in the West have traditionally filled end product needs in the cotton fiber market, such as combed yarn apparel, blends, and other uses with stringent fiber length and strength requirements. Consequently, the feasibility of new production systems must also hinge on the effects of the new system on the market and use potential of the cotton from the system.

Consideration must be given, in any change to a new production system, to how that system influences the product's ultimate use. The adoption and use of the narrow-row production system, which has shown various production benefits, would be on a sound basis only if the textile use potential of western cottons produced in narrow rows is not significantly changed from the uses normally made of western cottons and if any extra costs in processing do not exceed the reductions in production costs. Adequate consideration must be given to the place in the market for cottons from the new system if textile use potential is different from that of coventionally produced cottons in the area.

Three types of harvesters have been developed for harvesting cotton in narrow rows. The broadcast finger-type stripper was adapted from finger-type row harvesting principles (Kirk et al. *1964*, Tupper *1966*) and performs satisfactorily when cotton moisture content is low and plant height is controlled. Broadcast finger-type strippers are currently marketed by major farm machinery manufacturers. The broadcast cotton combine was developed by industry and tested in cooperation with State agricultural experiment station and Agricultural Research personnel (Tupper et al. *1974*, *1977*). The roll-type stripper developed for conventional row harvesting has been adapted to row spacings down to 18 to 20 inches (Parish and Shelby *1974*). Some of the self-propelled roll-type strippers available from major farm machinery manufacturers may be adjusted for row spacings narrower than the conventional 38 to 40 inches. Test results have shown that the trash levels from each of these harvesting methods are higher than those from conventional spindle pickers, even when the stripper harvesters are equipped with field extractors. The finger-type stripper is generally responsible for higher trash levels in western area cottons than the other narrow-row harvesters. Many cotton gins in the western area, even though elaborately equipped by most standards for spindle-picked cottons, may not be adequately equipped to handle the higher trash volumes associated with the narrow-row stripper-type harvesters.

The question of overall feasibility of a narrow-row once-over harvest production system for western area cottons remains to be resolved. Concurrent with research to resolve production feasibility, however, a study was conducted to determine the textile use potential of western cottons produced in a narrow-row system where crop and harvesting conditions were nearly optimum. The study objectives were to determine—(1) if western cottons produced in narrow rows and harvested with stripper harvesters equipped with field extractors will require more elaborate seed cotton cleaning systems i and (2) if the mill processing and spinning perform narrow-row systems cotton is comparable to that o tional-row systems cotton. Information from this s be used along with production feasibility informati evaluate the merits and overall economic balance o row-row cotton system for western areas.

Production and Harvesting

Production

The test cotton was produced to compare the perfo narrow-row and conventional cotton through prodı harvesting, ginning, and textile processing studies. grown by South Lake Farms located southwest of (Calif. The soil (Tulare clay) was quite salty (1.5 to millimhos/cm) with a clay layer about 14 inches be surface. The soil was prepared with a stubble disk rows with no deep tillage. All irrigations were appl basins and scheduled to minimize the growth probl associated with this soil.

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[2]The year in italic, when it follows the author's name, refers to Literature Cited, p. 8.

Acala SJ-1 cotton was planted on flat preirrigated soil on April 6 with row spacings of 20 inches and 40 inches. The two row spacings were compared in a four-replication randomized complete block design. The 20-inch plots were 64 rows wide and the 40-inch plots were 16 rows wide. All plots were 1,320 feet long. The resulting plant populations were 69,800 plants/acre for the narrow-row plots and 35,200 plants/acre for the normal-row plots. At harvest, the average plant heights were 25.3 inches for the narrow rows and 34.9 inches for the conventional rows, and the average number of nodes was 20.1 and 23.9 for the narrow and conventional rows, respectively. The narrow-row plots had fewer bolls per plant (5.5 compared with 8.7) and more bolls per square foot (8.8 compared with 7.2). The lint yields were 1,197 lb/acre for narrow rows and 978 lb/acre for conventional rows. Two applications of sodium chlorate (the second with paraquat[3]) were required to obtain adequate defoliation.

Harvesting

All cotton was harvested in clear, dry weather on October 21. A two-row spindle harvester in good mechanical condition with normal adjustment was used in the 40-inch row plots. An Allis Chalmers model 760 XTB stripper with finger-type head and integral saw-type cleaner was used for the narrow-row plots. A one-bale-equivalent seed cotton sample from each plot was placed in special shipping containers and transported to the Southwestern Cotton Ginning Research Laboratory, Mesilla Park, N. Mex.

Seed Cotton Description

The composition of the harvested cottons, based on seed cotton fractionation sampling, is shown in table 1. Significant differences in trash content were observed between the picked and stripped samples. These differences are depicted in figure 1. The stripped samples had higher percentages of burs, sticks, and total trash than the picked samples. There were no differences between stripped and picked samples for combined mote and fine or leaf trash contents. Total trash contents for the picked and stripped wagon samples were 8.5 and 26.0 percent, respectively, with a sample standard deviation of 2.01. The cottons were uniform enough from lot to lot that no differences were observed in the average trash contents of the cottons subjected to two different ginning treatments.

1.—*Percent foreign matter in harvested seed cotton*

ıction and ȷt system	Burs	Sticks	Leaf trash and motes	Total
h row spindle picked	[1]0.6 b	0.8 b	7.1a	8.5 b
h row finger stripped	14.7a	4.1a	7.2a	26.0a

followed by the same letter are not different based on the 0.05 level of Student's *t*

methyl-4,4'-bypyridinium ion.

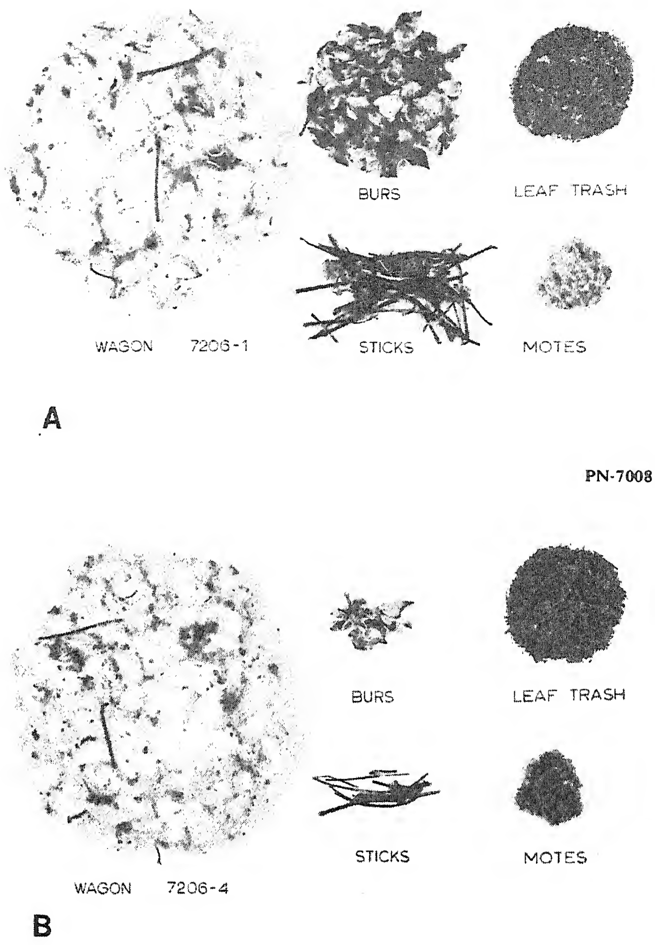

Figure 1.—Typical appearance of wagon samples of *(A)* narrow-row finger-stripped and *(B)* conventional-row width spindle-picked cottons with relative amounts of trash components from equal weight wagon samples of seed cotton.

Ginning Performance

The narrow-row finger-stripped cotton and the conventional-row spindle-picked cotton were each subjected to two different ginning treatments. A typical or "moderate" ginning system with three cylinder cleaners, one stick machine, and two lint cleaners was used as a check standard. The second or "elaborate" ginning system included additional bulk trash removal equipment and was composed of three cylinder cleaners, three stick machines, and two lint cleaners. Ginning system detail and operational parameters are shown in Appendix I.

Seed Cotton Cleaning

The response of the two types of cotton to the two seed cotton cleaning systems in the gin can be analyzed based on feeder apron seed cotton samples and on differences in wagon and feeder apron seed cotton samples.

Feeder Apron Seed Cotton Sample Analysis—Fractionation data for the feeder apron seed cotton samples are shown in table 2. Relative seed cotton sample appearance and trash component contents for the different harvesting-ginning

Table 2.—*Percent foreign matter in feeder apron seed cotton*

Treatment					
Harvest	Gin	Burs	Sticks	Leaf trash and motes	Total
Pick	Moderate	[1]0.1 c	0.3 b	2.0 b	2.4 b
	Elaborate	.0 c	.2 b	1.7 b	1.9 b
Strip	Moderate	3.4a	2.6a	2.8a	8.8a
	Elaborate	1.8 b	2.2a	2.7a	6.7a
Interaction, significance level		.05	(2)	(2)	(2)

[1]Means followed by the same letter or group of letters are not different based on the 0.05 level of Duncan's multiple range test.
[2]Significance level greater than 0.10.

treatments are shown in figure 2. Average component and total trash contents for the stripped samples remained significantly higher after seed cotton cleaning. Fine leaf trash and mote percentages, as previously noted, were not different at the wagon but were different at the feeder apron. This would indicate either that fine trash was generated from the larger trash components that were more abundant in the stripped cotton or that the fine trash-mote fraction of the stripped cotton was not as easily removed as it was from the picked cotton. Moisture differences between the stripped and picked cotton could have contributed to the trash differences after cleaning. The moisture content of the stripped cotton was significantly higher than the picked cotton (table 3). Clean seed cotton moisture content at harvesttime was equivalent for the two cottons, but the higher amount of high-moisture trash in the stripped cotton resulted in it reaching a higher equilibrium moisture content during the storage and transportation interval before ginning. The higher wagon seed cotton moisture content for the stripped cotton was consistently reflected in higher feeder apron seed cotton moisture content and in higher ginned lint moisture content (table 3).

Table 3.—*Percent wagon and feeder seed cotton moisture contents and lint moisture content sampled at first lint cleaner condenser*

Treatment				
Harvest	Gin	Wagon seed cotton	Feeder seed cotton	Ginned lint
Pick	Moderate	[1] 7.61 b	7.72 b	7.57 bc
	Elaborate	8.50ab	7.77 b	6.99 c
Strip	Moderate	9.82ab	9.57a	8.60a
	Elaborate	10.07a	9.48a	8.27ab

[1]Means followed by the same letter or group of letters are not different based on the 0.05 level of Duncan's multiple range test.

Analysis of a feeder apron bur content interaction shows that bur content for the picked cotton was approaching zero for the moderate gin treatment and could not be significantly further reduced by the elaborate gin treatment. Whereas, the bur percentage of the stripped feeder apron samples was

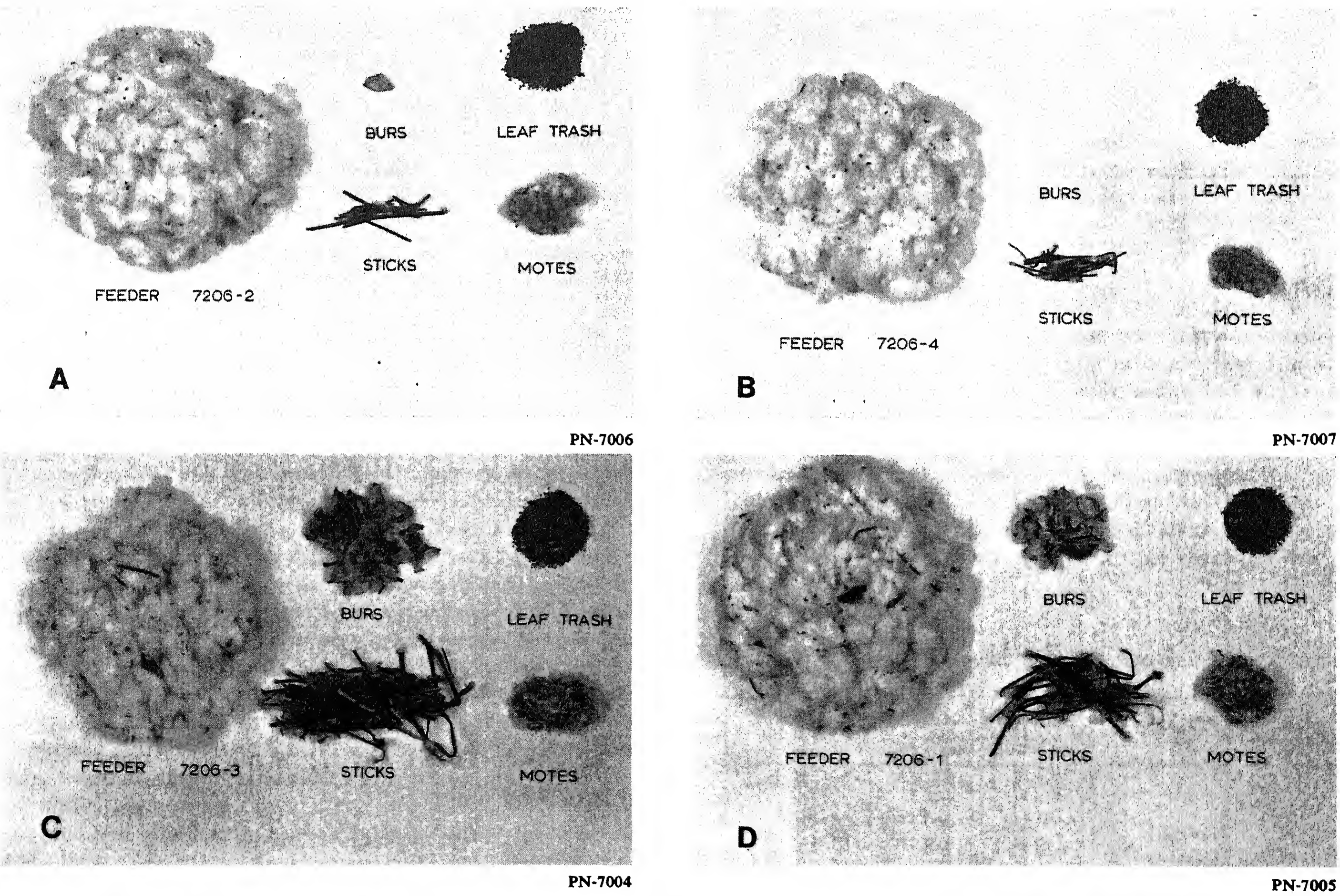

Figure 2—Typical appearance of feeder apron seed cotton, shown with relative amounts of trash components from equal weight seed cotton samples: *A,* Conventional-row width, spindle-picked, moderate gin cleaning; *B,* conventional-row width, spindle-picked, elaborate gin cleaning; *C,* narrow-row, finger-stripped, moderate gin cleaning; and *D,* narrow-row, finger-stripped, elaborate gin cleaning.

significantly reduced by the elaborate gin treatment as compared with the moderate gin treatment.

Total trash percentage at the feeder apron was 2.2 and 7.8 percent for the picked and stripped cottons, respectively. When both cottons were averaged, the elaborate gin treatment had significantly lower feeder apron total trash content than the moderate gin treatment at 4.3 and 5.6 percent, respectively. Sample standard deviation of feeder apron total trash content was 0.81. The feeder apron bur, stick, and total trash contents of the stripped cotton processed through the moderate seed cotton cleaning system were higher than the respective wagon trash contents of the picked cotton.

Seed Cotton System Trash Removal Analysis—Seed cotton cleaning system performance based on differences in wagon and feeder apron seed cotton fractionation data is summarized in table 4. The elaborate system removed more trash and had higher seed cotton cleaning system efficiency than the moderate system. The stripped cotton gave up more trash per unit of wagon seed cotton input. The percentage of trash removed was not different for the picked and stripped cottons.

Table 4.—*Seed cotton cleaning system trash removal efficiencies*

Treatment		
Harvest	Gin	Trash removed
		Percent
Pick	Moderate	[1]73.5 b
	Elaborate	79.2a
Strip	Moderate	72.5 b
	Elaborate	79.6a

[1]Means followed by the same letter or group of letters are not different based on the 0.05 level of Duncan's multiple range test.

Ginning

The cotton was ginned on a high capacity 16-inch-diameter saw gin stand. Ginning rate was lower for the stripped than for the picked cotton (table 5). Feed rate to the gin stand was controlled manually for optimum ginning by an experienced operator. Seed cotton processing rate was maintained by a constant automatic feed control setting. Average seed cotton process rate was 116 lb/min. Since the trash content of the stripped cotton was higher, the net flow rate of clean seed cotton was lower for the stripped cotton.

Table 5.—*Ginning rate and lint turnout*

Treatment			
Harvest	Gin	Ginning rate	Lint turnout from seed cotton
		Pounds lint/saw hour	*Percent*
Pick	Moderate	[1]27.5a	32.9a
	Elaborate	26.7ab	33.0a
Strip	Moderate	26.1ab	25.3 b
	Elaborate	25.6 b	24.7 b

[1]Means followed by the same letter or group of letters are not different based on the 0.05 level of Duncan's multiple range test.

Lint turnout averaged 32.9 and 25.0 percent for the conventional-row spindle-picked and the narrow-row finger-stripped cottons, respectively (table 5).

An analysis of cottonseed qualities was made on test lot samples. These data are presented in table 6. Trash content of the seed was significantly lower for the picked than for the stripped samples at 0.6 and 5.4 percent, respectively. The elaborate seed cotton cleaning system significantly reduced seed trash content, compared with the moderate system, for the stripped cotton but did not significantly change seed trash content for the picked cotton. The percentage of damaged seed was not affected by treatments imposed and averaged 7.5 percent. Seed linters contents were in the same range for all treatments, but a lower linters percentage was measured for the narrow-row stripped than for the conventional picked cottons. Seed moisture content was higher for the stripped cottons than for the conventional picked cottons, reflecting the same phenomenon discussed with respect to seed cotton moistures.

Table 6.—*Seed quality measures*

Treatment					
Harvest	Gin	Trash content of seed	Damaged seed	Linters content of seed	Moisture content (wet basis)
		Percent			
Pick	Moderate	[1]0.5 c	7.7a	14.6a	7.7 b
	Elaborate	.7 c	7.5a	14.7a	7.8 b
Strip	Moderate	6.7a	7.7a	14.1 b	9.6a
	Elaborate	4.0 b	7.3a	14.0 b	9.6a
Interaction, significance level		.01	(2)	(2)	(2)

[1]Means followed by the same letter or group of letters are not different based on the 0.05 level of Duncan's multiple range test.
[2]Significance level greater than 0.10.

Lint Cleaning

Lint cleaning system performance is shown in table 7. The lint cleaning system was composed of two saw-type lint cleaners and was the same for the elaborate and the moderate gin systems; however, the different harvesting and seed cotton cleaning treatments result in different lint trash characteristics and evoke different lint cleaning system responses. The stripped cotton gave up more waste per unit of ginned lint and had higher waste removal efficiency. The moderate seed cotton cleaning system resulted in higher ginned lint trash contents and, consequently, gave up more waste on lint cleaning than the elaborate system. The interaction on waste removed per unit of ginned lint reflects the same effect previously noted relative to the adequacy of moderate seed cotton cleaning on the picked cotton. Lint cleaner waste was not different for the moderate and elaborate systems on the picked cotton. Lint cleaner waste from the stripped cotton was lower for the elaborate than for the moderate seed cotton cleaning system.

Fiber samples were taken before lint cleaning, after one stage of lint cleaning, and after two stages of lint cleaning. Two stages of lint cleaning improved average classer's composite

grade index from Low Middling to Middling for the picked cotton and from Strict Good Ordinary Plus to Strict Low Middling Plus for the stripped cotton. Lint slide composite grades for the picked cotton from both the moderate and elaborate ginning treatments averaged Middling. Lint slide composite grades for the stripped cotton averaged Strict Low Middling for the moderate ginning system and Strict Low Middling Plus for the elaborate ginning system.

Classer's staple length was not significantly affected by the different production, harvesting, or ginning treatments. This was similarly observed in Fibrograph length measurements. Both Fibrograph length and length uniformity reflected reductions due to the two stages of lint cleaning. Trash content in lint samples was measured by the Shirley Analyzer. Sample nonlint percentage was significantly higher for the stripped than for the picked samples at the three sampling stages. Lint samples from the elaborate seed cotton cleaning system were significantly cleaner than those from the moderate seed cotton cleaning system following ginning and one stage of lint cleaning. This trend was also present following the second lint cleaner, but the difference was not significant.

Spinning Quality Evaluations

After ginning, the compressed bales were shipped to the USDA Pilot Spinning Laboratory in Clemson, S.C., for spinning quality evaluations that simulate commercial mill practice. The bales were treated as typical commercial cotton in that they were shipped by commercial carrier, stored in a cotton warehouse until spinning tests could be scheduled, and sampled for fiber quality tests similar to those used in spinning mills. Specifications on fiber tests are given in Appendix II. The cotton was processed into yarn by typical commercial yarn mill practices except that a somewhat finer-than-typical yarn was spun to make the spinning quality evaluations more sensitive to differences in fiber quality. Specifications on spinning quality evaluations are given in Appendix III.

Fiber Quality

Standard cotton classer's samples were cut from each bale of cotton and were classified by official USDA cotton classification methods. Instrument tests of fiber properties were made on subsamples selected at random from each bale.

Classer's Grade and Staple—Statistically, there were no significant differences in the colorimeter readings or in the classer's judgment of color, leaf, or composite grade for the different types of harvest or gin treatments (table 8). Agreement between the classer and the colorimeter was very close on the color of the ginned lint as well as clean lint, being equivalent in value to almost Strict Middling. A plot of the Rd (reflectance) and b (yellowness) values on the Nickerson- Hunter color diagram, however, indicated that the average grade for all four treatments fell at the top of the Good Middling Classification. Even though no statistical difference existed for the classers' designation for leaf, there was a measured mean difference of almost one-half grade for the leaf element of grade in favor of picked cotton. This is corroborated by the Shirley Analyzer nonlint measurements. Therefore, composite grades for stripped cottons could be expected to average slightly lower than for picked cottons.

Fiber Properties—Only one instrument-measured fiber property, elongation, resulted in a statistically significant difference for the test cottons. None of the differences observed were of any practical significance (table 8). Fiber length, length uniformity, strength, and micronaire reading were remarkably similar for all ginning/harvesting conditions.

Table 8.—*Fiber quality of ginned lint by treatments*

Quality item	Harvesting and ginning treatment			
	Picker		Stripper	
	Moderate	Elaborate	Moderate	Elaborate
Staple length, 32ds inch	[1] 35.0 a	35.0 a	35.0 a	35.0 a
Classification:				
Color, index[2]	104.0 a	105.0 a	103.0 a	104.0 a
Leaf, index[2]	98.0 a	100.0 a	96.0 a	95.0 a
Composite, index[2]	100.0 a	102.0 a	99.0 a	98.0 a
Shirley Analyzer waste, pct.	1.80a	1.83a	2.77 b	2.73 b
Colorimeter code (ginned lint), index[2]	104.83a	104.00a	104.00a	104.83a
Reflectance (Rd)	80.07a	77.83a	78.63a	79.83a
Yellowness (b)	10.17a	10.27a	10.13a	10.20a
Colorimeter code (cleaned lint), index[2]	104.83a	104.67a	104.00a	104.17a
Reflectance (Rd)	82.00a	80.93a	81.83a	81.83a
Yellowness (b)	10.53ab	10.47 b	10.90a	10.80ab
Fibrograph, 2.5-percent span length, inches	1.11a	1.12a	1.12a	1.10a
Uniformity ratio, pct.	46.0 a	46.0 a	47.0 a	47.0 a
Strength, 0-inch gage, 1,000 lb/in²	95.8 a	94.8 a	95.6 a	96.9 a
1/8-inch gage, g/tex	26.0 a	26.0 a	26.0 a	26.4 a
Elongation, pct.	6.13ab	6.17a	6.00 b	6.20a
Micronaire	4.7 a	4.6 a	4.7 a	4.7 a

[1]Means followed by the same letter or group of letters are not different based on the 0.05 level of Duncan's multiple range test.
[2]105 = Good Middling; 104 = Strict Middling; 100 = Middling; 94 = Strict Low Middling.

Nonlint Content—Analysis of the nonlint content as measured by the Shirley Analyzer showed that foreign matter, remaining in the cotton after elaborate gin cleaning, was no different than for the moderate cleaning setup. This was true for mechanically picked and stripped cotton; however, the amount of trash in stripped cotton increased significantly, amounting to approximately one percent, or almost 5 lb/bale.

Processing Performance

Processing performance was determined by spinning a 100-percent cotton yarn, performing objective tests, and making subjective evaluations of relative processing efficiency. Spinning tests involved over 27,000 spindle hours of processing for each condition studied.

No differences in the spinning performance of the different cottons could be determined from subjective observations. None of the cottons appeared to be any more inclined than others to lap around rollers. No differences in the amount of fly in the air could be determined. All test cottons appeared to spin well, and no difficulties in piecing up after end breakage were noted.

Processing Waste—Significantly higher processing waste at opening, picking, and carding was observed for the stripped cotton as compared with that for machine picked cotton as would be expected from nonlint tests on the Shirley Analyzer (table 9). Also, the elaborate ginning condition resulted in lower processing waste for the stripped cotton than the moderate condition. Processing waste for the stripped cottons averaged 4.97 percent as compared with 3.86 percent for the machine picked cotton. Approximately 85 percent of the waste occurred at carding in the form of flat strips or undercard waste. Elaborate ginning conditions reduced processing waste in stripped cotton by 1.10 percent compa.ed with moderate ginning conditions.

Yarn Breakage in Spinning—There were no differences in yarn breakage rates as measured by average ends down per thousand spindle hours. The potentially higher ends down rates for the stripped cottons due to the higher trash levels apparently were offset by the effective crushing action of the crush rolls used in carding.

Yarn Quality—Yarn spun from the test cottons was measured to determine if the experimental ginning and harvesting treatments resulted in changes in yarn strength and appearance. Some indications of potential yarn quality can be obtained from observations of the card web during processing; however, there were no indications of potential quality problems from any of the cottons, and the number of neps per 100 in^2 of card web was essentially the same.

Yarn appearance as compared with American Society for Testing and Materials (ASTM) yarn appearance standards was essentially the same for all cottons as was yarn irregularity as measured on the Uster Evenness Tester. Neps per thousand yards of yarn were less for the stripped cottons. This is the reverse of what is normally expected since neps are often associated with trash particles, and trash content of the stripped cottons was higher. This difference in nep levels was not apparent on the yarn boards used to assess visual appearance. Differences observed in yarn thick and thin places were not of practical importance.

There were no significant differences in yarn strength by the skein method or by the single-strand method.

Economic Considerations and Conclusions

Production, Harvesting, and Ginning

Curley et al. (*1970* and *1971-73*) reported on a series of field trials with narrow-row cotton in California's San Joaquin Valley. George and Yeary (*1977*) interviewed a number of growers in Tulare County, Calif., to assess the production, harvesting, and ginning costs for narrow-row and conventional 40-inch-row cotton. Two growers in their survey were producing narrow-row cotton on a commercial basis. The following general observations may be made from these

Table 9.—*Yarn quality and processing results by treatments*

Quality item	Harvesting and ginning treatment			
	Picker		Stripper	
	Moderate	Elaborate	Moderate	Elaborate
Neps, No./100 in^2 card web	[1] 4.00a	4.33a	4.33a	4.67a
Yarn strength, units	2115 a	2147 a	2186 a	2186 a
Yarn appearance, index[2]	86.0 a	86.0 a	89.0 a	87.0 a
Single strand data:				
Strength, g	174 a	172 a	171 a	174 a
Elongation, pct.	5.53a	5.07 b	5.23ab	5.07 b
CV[3], pct.	12.40a	13.63a	11.40a	13.53a
Neps, No./1,000 yd	937 ab	983 a	881 bc	839 c
Thick places, No./1,000 yd	3989 ab	4130 a	3895 b	3928 ab
Low places, No./1,000 yd	6704 a	6824 a	6643 a	6732 a
Irregularity CV, pct.	23.70a	24.17a	23.77a	23.80a
Waste, opening, picking, and carding, pct.	3.80 c	3.92 bc	5.42a	4.52 b
Ends down per thousand spindle hours, No.	62 a	62 a	59 a	59 a

[1]Means followed by the same letter or group of letters are not different based on the 0.05 level of Duncan's multiple range test.
[2]C = 85 to 94.
[3]Coefficient of variability.

studies: They found an average yield advantage of 10 percent in favor of narrow-row cotton. Lint grade differences, if any, tended to favor the conventional system over the narrow-row system. Narrow-row preharvest cash costs are lower than those for conventional-row cotton. Planting and seed costs are higher for narrow-row, but these costs are more than offset by lower costs for irrigation, cultivation, and fertilization. Narrow-row harvesting costs are less than conventional harvesting costs. This difference is offset by ginning costs that are higher for narrow-row stripped cotton than for conventional-row picked cotton.

In the earlier studies noted above, gins were charging the same rate for stripped and spindle-picked cotton; however, experience in western area gins now shows that stripper-harvested cotton generally reduces the ginning rate. Gin plants designed for processing machine-picked cotton could be expected to experience a reduced ginning rate when processing stripped cotton because of bottlenecks in the unloading system, seed cotton cleaning and conveying system, or the trash handling system. The ginning rate is reduced under these conditions because the seed cotton system does not deliver sufficient cotton to the gin stands to maintain the ginning rate. Two commercial gins in the San Joaquin Valley with substantial experience with stripped cotton estimate a one-third reduction in ginning rate in their plants as compared with ginning picked cotton. The ginners at those gins feel that the hundredweight ginning charge should be higher for stripped cotton than for picked cotton. The cost of ginning a bale of stripped cotton was 32 percent higher in our studies with a constant ginning charge per hundredweight of seed cotton.

In our studies, the narrow-row cotton yielded 22 percent more than the conventional 40-inch-row cotton, and the ginning rate was reduced 5 percent. A summary comparison of costs for producing narrow-row and conventional cottons in our studies is shown in table 10. A ginning charge of $2.25 per hundredweight of seed cotton was used for both picked and stripped cottons. The unit costs are based on the grower survey (George and Yeary *1977*).

Mill Processing

Spinning quality evaluations indicate that, on the basis of economics, mill processing of stripped cottons may compare favorably with processing picked cottons.

Only two of the quality and processing characteristics measured (processing waste and yarn elongation) appear to be sufficiently different to cause economic concern. These two characteristics would require analysis by individual mills to determine the extent of their effect.

Higher processing waste associated with stripped cotton in opening, picking, and carding results in direct economic loss to mills; however, this loss is somewhat modified by the resale value of the waste material. Considering the cost of handling, the cost of waste in early processing stages can reasonably be assumed to be directly proportional to percentage waste loss. Therefore, to be equivalent in value to mills, the price of picked cotton should be approximately 1.5 percent more than stripped cotton. In addition to a direct economic loss due to higher waste percentages, further losses due to handling the extra cotton necessary to offset the waste losses for production balance must be considered. Most of the waste occurred at carding. The total cost of producing card sliver is approximately $4.50/100 lb. For every 100 lb of card sliver produced from conventional, machine-picked cotton, it would be necessary to handle 101.5 lb of narrow-row stripped cotton, resulting in approximately $0.07 increase in processing cost per 100 lb of sliver.

Yarn elongation is normally measured by scientists studying processing performance and fiber properties, but very little is known about its subsequent effect on processing quality. It is often suspected of being related to loom stops in weaving, but no consistent relationships involving yarn elongation have been developed. The magnitude of the differences observed in elongation is so small that the effect is estimated to be no greater than the effect of extra costs due to processing waste. These costs are very small compared with the cost savings associated with changing to narrow-row stripped cottons.

Table 10.—*Production, harvesting, and ginning costs*

Operation or category	Conventional costs		Narrow-row costs	
	Per acre	Per hundredweight of lint	Per acre	Per hundredweight of lint
	Dollars			
Preharvest cash costs	244.18	24.97	240.17	20.06
Harvesting costs	93.58	9.57	67.03	5.60
Ginning costs	66.60	6.81	107.73	9.00
Total harvesting and ginning costs	160.18	16.38	174.76	14.60
Miscellaneous costs	7.27	.74	8.85	.74
Total cash costs	411.63	42.09	423.78	35.40
Total cost of production	580.46	59.35	592.61	49.51
Less seed credit	88.80	9.08	108.69	9.08
Net cost of production	491.66	50.27	483.92	40.43

Even though limited experimentation and economic analysis indicate significant cost savings can result from narrow-row stripped cotton with little or no loss in yarn quality, stripped cotton is considered inferior in some segments of the industry. Further studies should be planned—considering the effects on cotton dust levels and rotor deposits in open-end spinning—to determine if the apparent cost savings can be maintained.

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Appendix I: Ginning System Description

The two cottons, narrow-row finger-stripped and conventional-row spindle-picked, were subjected to two ginning treatments: A setup typical of many California gins (called "Moderate" in this study), including a drier, six-cylinder cleaner, six-cylinder cleaner, stick machine, six-cylinder cleaner, and two saw-type lint cleaners, and a setup that includes additional bulk trash removal equipment (called "Elaborate" in this study), including a drier, six-cylinder cleaner, stick machine, six-cylinder cleaner, stick machine, stick machine, six-cylinder cleaner, and two saw-type lint cleaners. The drier controls for both gin setups were set to 160°F inlet temperature. Seed cotton feed rate was based on a constant automatic feed control setting for all treatments and averaged 6,980 lb of seed cotton per hour on 50- and 72- inch nominal-width cleaners and stick machines, respectively.

Appendix II: Fiber Testing

Fibrograph measurements, Pressley 0-inch gage and Stelometer 1/8-inch gage strength tests, and Micronaire fineness readings were made on four subsamples of ginned lint from each cotton bale. The following measurements were made on each subsample by two technicians:

Instrument	Measurements[1] Per technician	Per sample	samples	Total measurements per bale or lot
	Number			
Fibrograph	2	4	4	16
Pressley 0-inch gage	2	4	4	16
Stelometer 1/8-inch gage	2	4	4	16
Micronaire (1 technician)	1	2	4	8

[1]Color measurements were made on ginned lint samples before and after Shirley Analyzer test.

Source: Official classification data were obtained from the Board of Supervisory Cotton Examiners, Memphis, Tenn.

Appendix III: Spinning Quality Evaluations

The bales were delivered to the opening room, and the ties were removed 12 h before cotton was processed through the picker. This allowed the cotton to "bloom" and condition.

Each bale was fed through an opening and picking line, consisting of four hopper feeders, Superior cleaner, and a one-process picker. The one-process picker consisted of two sections. The first section was equipped with a blade beater; the second, with a Kirschner beater. This opening and picking line was set up to produce a 14-oz. picker lap. The picker laps were moved to the cardroom and conditioned for a minimum of 12 h before they were carded.

The carding operation was set up to produce a 50-grain sliver at a production rate of 10 lb/h. During the carding of each lap, separate nep counts were made by two technicians. Three nep boards were taken at each of four equal intervals during the carding of the laps. The first board was taken when the lap was one-fourth completed.

Two processes of drawing were used, feeding eight ends up into breaker and finisher drawing, with an operating speed of 265 ft/min. The first process produced a 53-grain sliver; the second, a 55-grain sliver.

The roving process was set up to produce 1.25 hank roving when using a 1.30 twist multiplier and a spindle speed of 1,200 revolutions per minute (r/min).

In the spinning process, 50s carding filling yarn with a 3.70 twist multiplier was spun with a spindle speed of 13,000 r/min from a single creel of 1.25 hank roving. New travelers were used for each lot and the spinning frames were allowed to run for 30 min before an ends-down count was made. This interval served as a break-in period for the travelers and also produced yarn for sizing, so that the correct draft gear could be determined.

The spinning test for each lot consisted of running a full doff. This required 9½ h of continuous frame operation, or 9,120 spindle hours. Ends down were recorded in 15-min intervals, and these data were combined so that ends down per 1,000 spindle hours could be determined.

The processing sequence was:
(1) Opening equipment: Four blender feeders; Superior cleaner
(2) Picker: Two-section, one-process picker
(3) Carding: Three standard cards
(4) Drawing: Two-process drawing
(5) Roving: Rovematic
(6) Spinning: Single creel roving spun on Duo-Roth system of drafting; four 240-spindle frames.

From each spinning lot (bale), 10 bobbins of yarn from each of the spinning frames (40 bobbins) were tested for skein strength and yarn size.

Sixteen bobbins were tested for yarn evenness and imperfections. The sensitivity of the evenness tester was set at 30 percent for thin places and at setting number 4 for thick places and neps. Yarn from each bobbin was tested at 25 yd/min for 5 min (2,000 yd/lot). Imperfections are reported per thousand yards.

Single strand strength tests were made on 40 bobbins, 10 breaks per bobbin.

Yarn grade was determined from three yarn boards per spinning lot by three technicians.

Appendix IV: Statistical Procedures

The 12-lot study was set up in a factorial arrangement of treatments consisting of two harvesting treatments times two ginning treatments times three replications. The treatments were blocked in replications. Analyses of variance were based on the following partition of degrees of freedom: For single treatment observations—

Source	*Degrees of freedom*	
Total (corrected)	11	
Blocks	2	
Treatments	3	
Harvest		1
Gin		1
Harvest × Gin		1
Error	6	

For duplicate treatment observations—

Source	*Degrees of freedom*	
Total (corrected)	23	
Blocks	2	
Treatments	3	
Harvest		1
Gin		1
Harvest × Gin		1
Error	6	
Sampling Error	12	

For triplicate treatment observations—

Source	*Degrees of freedom*	
Total (corrected)	35	
Blocks	2	
Treatments	3	
Harvest		1
Gin		1
Harvest × Gin		1
Error	6	
Sampling Error	24	

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